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Short Communication

Observations of fire occurrences on high-elevation tepui summits quasi-isolated by cliffs

Mateusz Wrazidlo[1], Lionel Hernandez[2], Freddy Vergara[3]

1 *RootSpace, 44-200 Rybnik, Poland*
2 *Universidad Nacional Experimental de Guayana, Apartado postal 8050, Ciudad Guayana, Estado Bolívar 8015, Venezuela*
3 *Theraphosa Asociación Cultural y Explorativa, Puerto Ordaz, Venezuela*
Corresponding author: Mateusz Wrazidlo (explority@explority.eu)

Abstract

A team undertaking an expedition to the plateau of Mount Roraima (also known as Roraima-tepui) in Venezuela between April and May 2023 found and documented fresh traces of a fire in the central part of the summit of the mountain, which damaged a large portion of a montane Pantepui habitat with local endemic plant species. The observation has baffled scientists, park guards, and local community leaders, who have never seen a fire in this particular area and worry that the case might be an indicator of increasing threats the unique montane ecosystem could face in the near future. This article provides insight into this case, supplemented with historical records and a discussion of possible causes and consequences of uncontrolled fire occurrences in the high-tepui environment.

Key words: Canaima National Park, fire, Mount Roraima, Pantepui, Roraima-tepui, Roraima, Venezuela, wildfire

Introduction

On 4 May 2023, observations of fresh traces of a fire in the central area of the summit of Roraima-tepui (Fig. 1) were made, which, according to the information available, would be the first record of a fire on the top of this mountain (Ablan et al. 2005).

Roraima-tepui, like many other tepuis in the Guiana Shield, is a tabular highland plateau (1,500–2,995 m altitude), isolated from its surroundings by cliffs (quasi-vertical walls or escarpments) of rock and generally with a perhumid climate (Huber 1995a; Corrales 2004). During the 13 years (1986–1999) that CVG-EDELCA carried out the fire registry of the fire control program in the Upper Caroní River basin (where Roraima-tepui is located), no fires were recorded on high-tepuyan summits (Ablan et al. 2005). Such features lead to the following question—how can a fire start on the top of a high-elevation tepui summit like Roraima-tepui?

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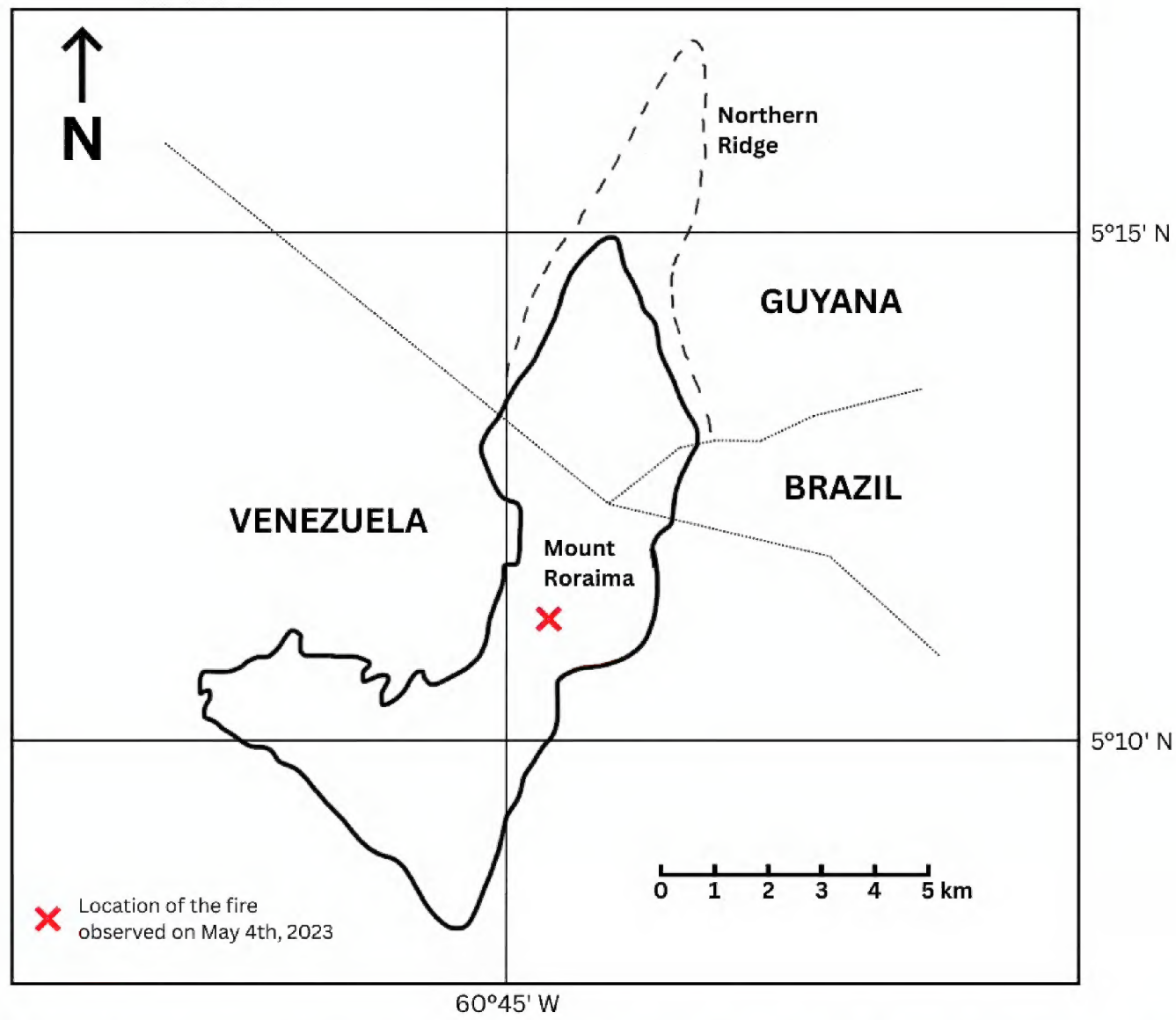

Figure 1. Map of Roraima-tepui, with the marked location of the fire observed on 4 May 2023. Map by M. Wrazidlo.

Observations from the recent fire occurrence on Roraima-tepui, which took place in May 2023

Initial observations from May 2023

On 4 May 2023, at approx. 2:40 PM, the team traversing the summit of the plateau of Mount Roraima in Venezuela in the northerly direction (heading toward a depression known as El Foso) noticed the smell of smoke, initially taking it as traces of smells originating from the burning savannas in the vicinity of the mountain being carried by the wind. After a few minutes, the team members reached a rocky overhang with visible traces of a recent fire, with some spots still smoldering and giving off noticeable heat. Extensive damage caused to local plant colonies and a layer of fresh ash were observed around the perimeter. The area affected by the fire was assessed to cover approx. 160 m^2.

In the photos of the fire site taken by Wrazidlo, traces of a fire can be seen at the base of a rock wall that burned a patch of shrubland with sparse cover on a sandy substrate and surrounded by meadows of *Stegolepis* spp. in the lower part and rocky cliffs in the upper part (Fig. 2A). Burnt plants of *Bonnetia* spp., *Tillandsia turneri*, *Epidendrum alsum*, *Connelia augustae*, and *Cyrilla racemiflora* were seen (Fig. 2B, C), as well as other plant species not yet identified.

The most affected area, right on the escarpment leading up to the vertical rock wall, was covered in an ankle-deep layer of fresh ash. Burn marks and discoloration caused by heat were apparent on the rocks scattered around the area (Fig. 3A).

It is noted that the fire only affected a patch of the plant community in close proximity to the fire source and that it could not spread to the wetland meadow

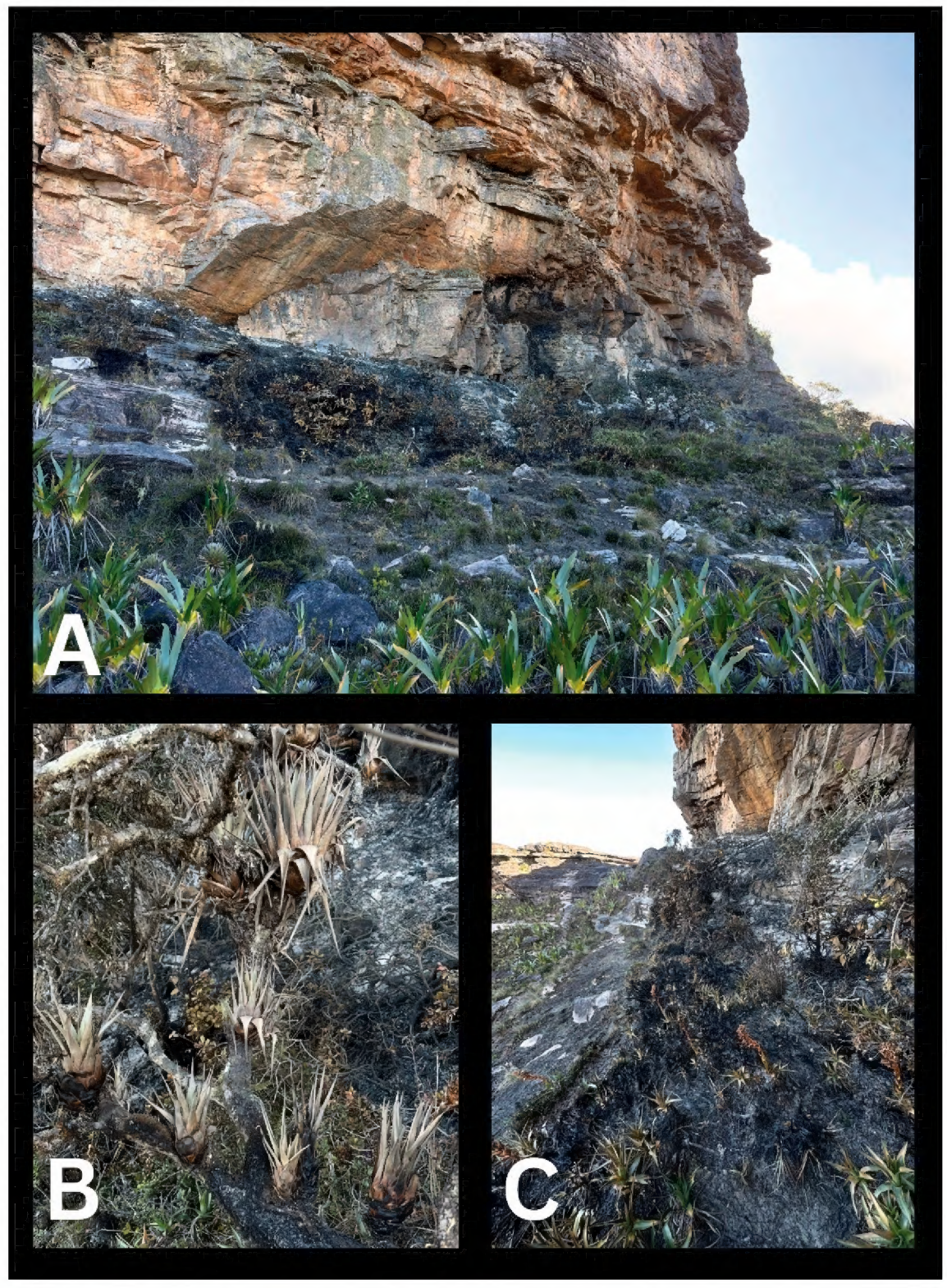

Figure 2. Area affected by fire found on the summit of Roraima-tepui on 4 May 2023. **A.** Overview of the burned area; **B.** Burned vegetation—dead specimens of *Tillandsia turneri* observed around the perimeter of the area affected by the fire; **C.** Burned vegetation—with damaged specimens of *Connelia augustae*.

community of *Stegolepis* spp., settled on peat, the most humid site with water flowing over the underlying rock, where the accumulation of organic material, dark brown in color, typical of histosols of peat, is observed (Fig. 3B).

If the strong winds prevailing at the summit and the three essential elements for combustion to occur are considered, oxygen would be the most abundant element at the fire site. According to the information available, there was no precipitation for several days before the visit (Wrazidlo, pers. comm.), so it is presumable that the drought could have contributed to the drying of the vegetation, but the source of heat still remains to be known. The fire site is the base of a vertical rock face or cliff with an opening in the wall covered by an overhang that offers shelter from the rain, i.e., an ideal site for camping. As explained before, it is unlikely that the fire was caused by natural causes, so it could be speculated that perhaps one or several people camped and made a fire, which they left burning when they left the place, that could have been the source of ignition.

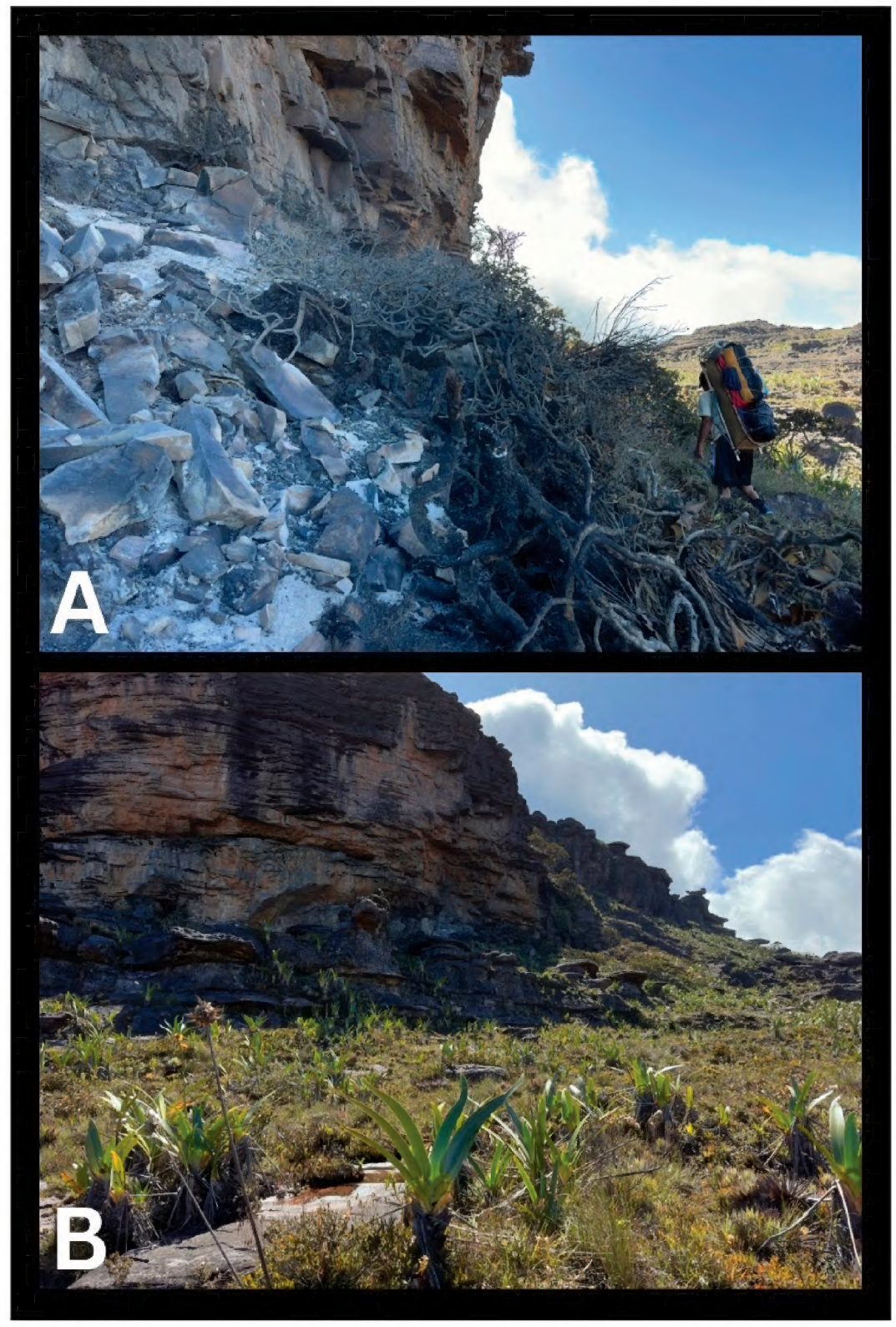

Figure 3. Area affected by the fire and its surroundings. **A.** Burn marks and discoloration visible on the rocks at the site; **B.** *Stegolepis guianensis* meadow was unaffected by the fire, with the fire's location visible in the background.

Follow-up visit at the fire site in April 2025

The site of the fire on Roraima-tepui recorded in May 2023 was revisited by a team led by Tensing Rodriguez in April 2025. Two years after the occurrence of the fire, significant damage to plant communities remained notable at the site, with burn marks still clearly visible on sandstone surfaces (Fig. 4). The plant species exhibiting the most intense regrowth was a member of the Asteraceae family. Notable recovery was also observed in populations of *Tillandsia turneri* growing epiphytically on shrub branches surrounding the site, while the shrubs themselves still appeared to be dead, with no visible signs of regrowth. Fresh foliage was also observed on a few of the *Connelia augustae* plants scattered around the site.

Possible causes of fire in the high-tepui zone

The possible causes of fire in the high-tepui zone can be natural or anthropic. One is the possibility of a fire originating in the surrounding savannas or forests that spreads to the summit through vegetation on the slopes and escarpments,

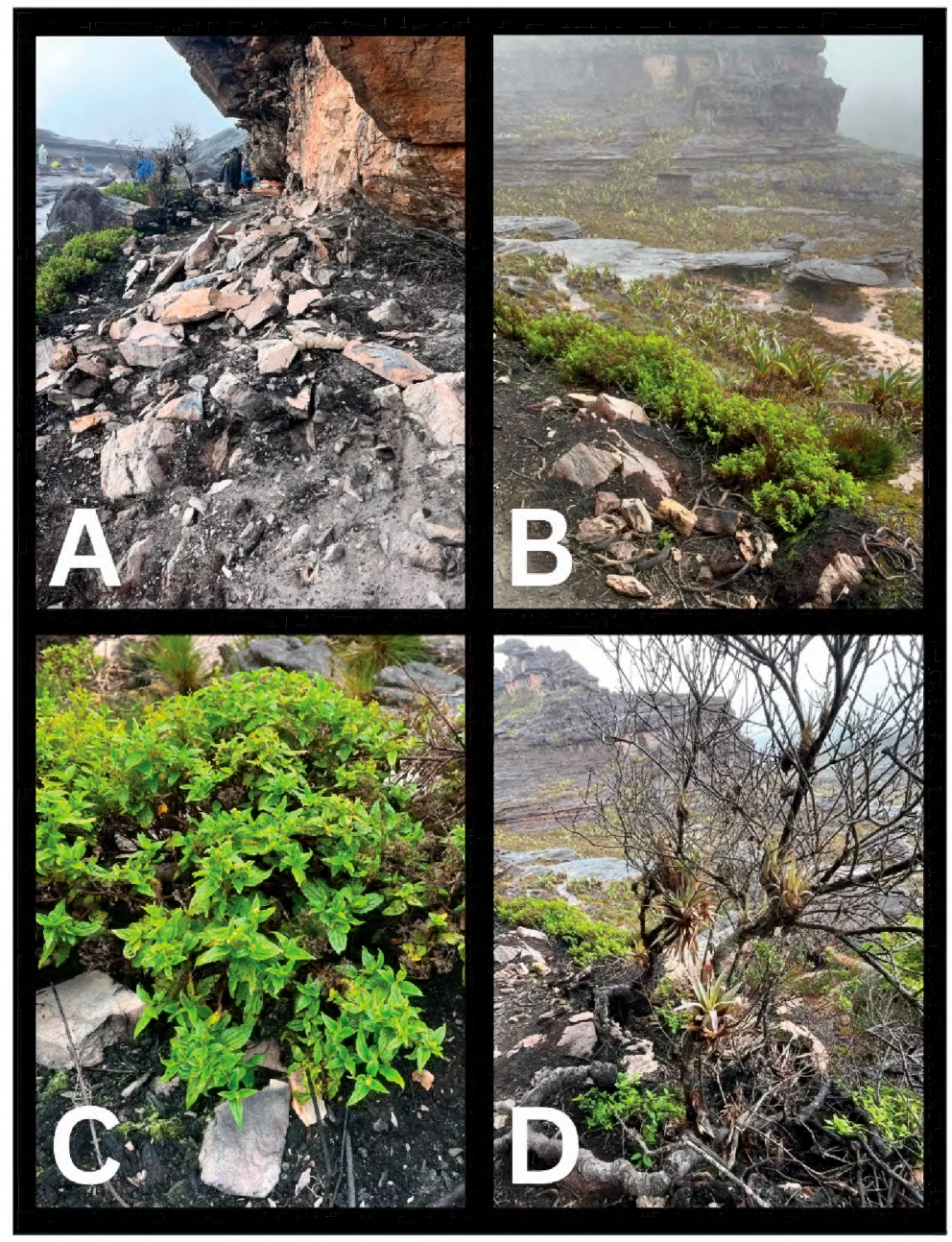

Figure 4. Area affected by the fire revisited in April 2025. **A.** Burn marks and discoloration visible on the rocks at the site; **B.** Pioneer Asteraceae populations with intense regrowth visible. Note the clear boundary between the burned area lacking vegetation and the unaffected *Stegolepis guianensis* wetland below; **C.** Close-up of the Asteraceae plants being a dominant species around the area affected by the fire; **D.** Recovering *Tillandsia turneri* plants on a dead shrub. Photographs by T. Rodriguez.

just as it occurred on the southwestern flank of Roraima-tepui (Tate 1932). Another possible explanation, not yet observed or proven, would be large fires coming from the surrounding lower lands frequented by man-made fires, from which ignited particles could rise to the peaks through convection columns. Another alternative could be electrical discharges as possible sources of ignition, but this is unlikely since lightning occurs during the rainy season. After almost two centuries of visits by numerous scientists and explorers (especially during the dry season), there are still no reliable reports of fires caused by lightning or other natural causes on high-tepuyan summits (Gorzula and Huber 1992; Huber 1995b; Rull et al. 2019). Anthropic fires being the ones with the highest probabilities, a brief review of known events is presented below.

Other records

Fire on the southwestern talus slopes of Roraima-tepui in April 1926

There is a possibility of a fire originating in the savannas or forests surrounding the tepui that spreads to the summit through vegetation on the slopes and escarpments, just as it occurred on the southwestern flank of Roraima-tepui

(Tate 1932). Holdridge (1933), an eyewitness, reported that the forests on the basal slopes burned for several days during the great fire of April 1926 at the end of the unusual mega-drought of 1925–1926; the fire almost reached the top of the plateau through the "ledge" (known as "La Rampa") leading to the top but was unable to advance through the sparse vegetation there (Tate 1932). The event has left a lasting influence on the biodiversity of Roraima-tepui, with instances of some species being likely completely eradicated from the escarpments of the mountain. An example is probably the absence of *Heliamphora nutans* from the southwestern talus slopes of Roraima-tepui. *Heliamphora nutans* was first observed by Robert Schomburgk in 1938 during his first expedition to the base of Mount Roraima, in a marshy habitat under the vertical cliffs of the mountain, and later relocated during another expedition together with Robert's brother, Richard Schomburgk, in 1841. Ever since those observations took place, the species has been recorded only from the summit of Roraima-tepui (McPherson et al. 2011).

Fire on the southeastern talus slopes of Auyán-tepui in March 2024

An analogous situation to the 1926 fire on Roraima-tepui slopes happened in 2024 on another tepui in Canaima National Park, namely Auyán-tepui. An extensive fire started on 10 March 2024, on the savannas near the indigenous Kamarakoto communities of Uruyén and Kavak and continued burning for several days (El Estímulo 2024), with the extent of the fire reaching as high as the upper escarpments of the massif (Fig. 5), as indicated by photographs published online (La Patilla 2024). Although the cause of this fire was most likely savanna burning carried out by members of the local indigenous communities, which is known to be a traditional practice among the Pemón communities in the Gran Sabana (Sletto and Rodriguez 2013), under usual circumstances the fire is unlikely to penetrate into the perhumid areas of the Pantepui biogeographic zone (above approx. 1,500 m of altitude (Huber 1995a)), known for their capacity to buffer regional climatic changes (Zinck et al. 2011) and, in effect, display long vegetation constancy, even in the case of environmentally sensitive species (Rull et al. 2019).

Other cases, studies, and observations

Galán (1984) reports (without indicating which are the tepuis) "the presence of unequivocal traces of fires on the top of several tepuis, like large burned trunks in the middle of vast expanses of secondary scrub without a single living tree specimen." Galán (1984) also indicates that "The presence of the Pteridium fern (considered a sure indicator of burned areas) is also possible evidence of the occurrence of at least one fire both in the massif of Chimantá and in Auyantepuy." Regarding the latter, until now, from all high-tepuyan summits, only the botanical collection of *Pteridium arachnoideum* has been reported on Roraima-tepui (Safont et al. 2014) and *Pteridium aquilinum* on Auyán-tepui (Gorzula and Huber 1992). In the case of Chimantá, Galán's report is not true, because no investigator who has visited it has reported fires there (Gorzula and Huber 1992; Rull et al. 2019).

Figure 5. Fire on the massif of Auyán-tepui in March 2024. **A.** Fire reaching the upper talus slopes of Auyán-tepui; **B.** Park rangers observing the extent of the fire from the upper talus slopes of Auyán-tepui. Photographs by Elio Manrique.

Gorzula and Huber (1992) emphasize that after having studied more than 30 tepui summits for two decades, “that in no case has evidence been found of the occurrence of spontaneous fires, caused, for example, by lightning. The only high-tepuyan site with evident signs of recent burning, is an area of approximately 40 km2 of the western branch of the Auyán-tepui. This has been the victim of a fire that escaped the control of the workers of the camp <Río Lomita> (at 1,800 m), during the botanical expedition of J. Steyermark in May 1964 (Steyermark, 1967). Today the weather station. <Auyán-tepui Centro> of CVG-EDELCA is located in this area....” At this site, it was found that at the beginning of this century burned tree trunks still persisted (Señaris, pers. comm.).

Gorzula and Huber (1992) comment that Givnish et al. (1986), taking as reference a single fire event that affected the vegetation of Cerro de la Neblina (at 1,750 m), tried to demonstrate that a certain typical high-tepuyan shrub life would present a series of morphological adaptations for fire survival, stating that fire would be frequent on the tepui summits. Certainly many typically high-tepuyan plants are easily flammable; Gorzula and Huber

(1992), however, refute such a claim by Givnish et al. (1986), not only because it is based on a single case referring to a single species (*Bonnetia maguireorum*) but also because, as mentioned above, there is no reliable report of spontaneous fire events due to lightning or other natural causes on high-tepuyan summits for almost two centuries of exploration.

According to Huber (1988), 20% of the summits of the tepuis are isolated plateaus that present the typical tabular morphology of a plateau with rock cliffs. The remainder are roughly more pyramidal in shape with gradual slopes and are therefore connected to the surrounding land, either by fully vegetated ridges, extensive valleys, or gently sloping slopes, which facilitates the spread of fire from neighboring savannas to the tepui top (Safont et al. 2016; Rull et al. 2019).

Reports of fires in the summits of tepuis with pyramidal morphology include the fire in 1945–46 of the forests of Sororopán-tepui (2,050 m) (Steyermark 1966; Mayr and Phelps 1967) and the burned trunks on the summit of Uei-tepui (2,150 m) (Hernández 1999; Safont et al. 2016).

Not only modern observations, but also palynological studies rule out the possibility that fire may have influenced the vegetation changes observed on the summits of the tepuis.

Palynological studies on the summits of Apakará-tepui (Rull and Montoya 2017) and Eruoda-tepui (Nogué et al. 2009) in the Massif of Chimantá and also on Guaiquinima-tepui (Rull 2005) found small particles of charcoal (ash) in late Holocene sediments; such a small size favors their dispersal by wind, arguing that these ash particles likely originated from the surrounding Gran Sabana uplands, where Holocene fires were frequent (Rull et al. 2019; Montoya, pers. comm. 2023).

Conclusion

The recent fire on the summit of Roraima-tepui (as well as the fire that affected a substantial area of the Auyán-tepui massif) constitutes a disruptive, harmful event that underscores the increasing vulnerability of the highland ecosystems in the Guiana Shield to unprecedented anthropogenic pressures and environmental forcings. This incident should not be interpreted as an isolated occurrence but rather as the outcome of a complex interplay of factors that are progressively altering the ecological dynamics of the plateau.

Foremost among these drivers is the sustained rise in unregulated tourism, marked by a growing influx of visitors—often accompanied by guides lacking adequate training or ecological awareness—who traverse the tepui without adherence to established routes or impact mitigation protocols. This has led to the proliferation of unauthorized trails, trampling of endemic plant communities, and disturbance of sensitive habitats such as the isolated, montane Pantepui wetlands, thereby compromising the ecosystem's structural and functional integrity.

Concurrently, the presence of exotic plant species such as *Poa annua* L. and *Polypogon elongatus* Kunth, as well as human-transmitted infectious fecal bacteria (*Helicobacter pylori*), has been documented on the summit (Rull 2016). While further empirical research is needed to establish a direct causal link, it is hypothesized that these invasive grasses—by accumulating

dry biomass during extended dry seasons—may be contributing to an increased fine fuel load, potentially facilitating fire ignition and spread in an ecosystem historically devoid of natural fire regimes. What is more, severe droughts are common on the summit of Roraima-tepui and have a strong impact on local vegetation (Kok et al. 2024), which can also contribute to generating conditions in which fires are more likely to occur.

Superimposed on these local stressors is the broader context of global climate change, characterized by prolonged dry periods, elevated temperatures, and heightened climatic variability. These conditions act as amplifiers of existing vulnerabilities, creating a feedback loop that may render such disturbance events more frequent and severe.

In light of this emerging risk landscape, there is an urgent need to reassess current access, management, and conservation strategies for Roraima-tepui. The implementation of integrated approaches—including meteorological and ecological monitoring, invasive species control, stringent regulation of tourism, and the strengthening of local stewardship capacities—is imperative to mitigate cumulative impacts and safeguard the ecological functionality and biocultural significance of this irreplaceable landscape.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Use of AI

No use of AI was reported.

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Author contributions

Conceptualization, M.W.; fieldwork and *in situ* observations, M.W.; validation, M.W. and L.H.; formal analysis, L.H. and F.V.; investigation, M.W., F.V., and L.H.; writing – original draft preparation, M.W., F.V., and L.H.; writing – review and editing, M.W., F.V., and L.H. All authors have read and agreed to the published version of the manuscript.

Author ORCIDs

Mateusz Wrazidlo https://orcid.org/0000-0001-5383-1906
Lionel Hernandez https://orcid.org/0000-0002-7279-1003

Data availability

Data are contained within the article. The original contributions presented in the study are included in the article; further inquiries can be directed to the corresponding author(s).

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